And the light shineth in darkness

A recent bidding process to provide for electricity to regulated consumers in Chile - 12.430 MWh per year for 20 years starting in 2021 - could constitute itself into a structural shift in the market. At a price of US$ 47.59 per MWh of energy fully indexed to the US CPI plus a power capacity retribution normalized around US$ 10 to US$ 15 per MWh – with a higher retribution as backup power is more reliable -, total price conditions per MWh differ substantially from previous ones. Ongoing equivalent contracts that sum up to 37.489 MWh per year centered in the next 10 years average at present time US$ 79.18 per MWh for the energy component[1] – approximately 70% indexed to the US CPI -, **a US$ 30 plus difference per MWh**, while their power capacity retributions are pretty similar. Considering both major electricity systems in Chile, SIC in its central and southern portion and SING in its northern sunny one, which by the end of 2018 will be connected under one unique grid, 37.489 MWh per year represent close to 60% of total electricity consumption in this country. The price signaling from these contracts is therefore huge, both in the electricity market, where non regulated users - mainly mining operations - consume the remaining 40%, and in the other energy markets that partially substitute for it via imported oil, LNG and LPG. In Chile, close to 44% of total primary energy goes through electricity, which is why a non competitive electricity market pervades far beyond it. There also remains to be solved an un-competitively delicate network of crisscrossing equity participations among the biggest participants in the energy sector that should be broken up as time goes by.

What happened? Since mid 2014 all fossil fuels saw their prices tumble closer to long term values. For example, oil prices averaged US$ 43 per barrel since 1950, or US$ 58 per barrel since 1990, in 2015 US$. Only twice in this long history had oil shortly reached US$ 100 per barrel, in 1980 with the Iranian crisis and in recent years, where world growth went basically beyond its short term capacity, pushing up prices to unsustainable levels on a commodity-wise basis. In both instances, the impact was so huge that inevitable adjustments followed, as they will always occur: technological breakthroughs such as *fracking* will continue happening. Besides these fuel price corrections, renewable investments costs in wind and solar generation had undergone substantial improvements and were credibly expected to continue. In other words, variable costs – fossil fuels – returned to normalcy and fixed investment costs in renewable energies went dramatically down.

But was it sufficient to have these better economic conditions to be reflected into prices? No, and it did not happen before even under conditions that were realistically expected to shortly converge to long term ones. For that to occur, incumbents had to be effectively challenged. Having a 5 year period to deliver electricity allowed non-incumbents to depend on their own solutions; having a 20 year period contract made financing easier; having many bidders, foreign and national, contributed a lot; having structurally lowered discount rates amplified marginal project feasibilities. But what could have been even more decisive was the perception that competitive

[1] Reporte Mensual del Sector Eléctrico, SIC y SING, agosto 2016, SYSTEP.

"deviations" under any form were to be harshly punished. And this was news, albeit silently referred to. **For a long decade Chile had witnessed long term contracts overpriced around US$ 20 per MWh relative to what it should have faced, after considering cost fuel differences with respect to foreign markets. And that was enough.**

In the particular case of solar photovoltaic plants, given solar irradiation in northern Chile, a 5% after tax real return is achievable assuming initial investments of US$ 1 million per MW and selling energy at prices around US$ 40 per MWh, allowing power capacity retribution to pay for operational and maintenance costs. Based on present investment costs for solar tracking plants and its trajectory, it is credible that within this five year period those investment costs will be real.

Of course this new economic set up will imply a downward price correction on current electricity generation assets values. That is what happens when markets gets competitively perfected and new technologies enter into playing, under a structurally low long term interest rate environment. Let us hope lessons from this bidding process are well understood in the electricity market and all the other ones. Regaining a long term growth path requires this kind of adjustments, as well as reasonable public policies which these last years our country has lacked of.

And the darkness comprehended it not[2].

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Annex

The following tables compare Chilean and US electricity systems: even under no growth in total electricity consumption in the US since 2007, its per capita consumption is thrice the Chilean one, consistent with GDP per capita differences.

Per capita electricty generation / consumption *			
Source: Chile CNE Dec 2015; US EIA June 2016; World Bank			
	Chile	US	US / Chile
Population (millions)	18	325	
kWh per capita per year	3.853	12.575	**3,26**
GDP per capita (current US$)	13.383	55.836	**4,17**
* There is a loss from generation to effective sales at consumer level			

[2] John 1:5-9 King James Version "And the light shineth in darkness; and the darkness comprehended it not".

In terms of electricity generation capacity, Chile has 22.000 MW of power and the US, 1.066.000 MW. In Chile, coal and natural gas sum 42% and hydroelectricity, 28% - diesel presence as a primarily backup is particularly notorious in Chile - ; in the US, coal and natural gas explain 70% of power and nuclear, 9% of it. Green energies capacities in Chile account for 41%; in the US, 16%.

Electricity Generating Capacity, in GW				
Source: Chile CNE August 2016 (SIC+SING), US EIA June 2016.				
	Chile	**%**	**US**	**%**
Coal	4,71	**21%**	273,03	**26%**
Natural gas	4,57	**21%**	444,93	**42%**
Diesel / FOil	3,05	14%	34,86	3%
Nuclear	0	0%	99,79	9%
Hydroelectric	6,17	**28%**	79,88	7%
Wind	1,22	6%	74,26	7%
Solar PV+Th	1,39	6%	14,94	1%
Biomass	0,32	1%	14,07	1%
Others	0,67	3%	30,2	3%
TOTAL	**22,1**		**1066**	

Given a capacity factor over 90%, nuclear generation in the US represents 20% of total electricity generation; natural gas generation has already surpassed coal based one, having been around 50% for a long time before. Shale gas technological revolution in the making … In the Chilean case, hydroelectricity represents 34% of total generation, less than coal. The impact of renewable energies in the aggregate is to be seen in the future yet; Patagonia hydroelectricity potential unaccounted yet.

Electricity Generation, in TWh				
Source: Chile CNE Dec 2015 (SIC+SING), US EIA LTM June 2016				
	Chile	**%**	**US**	**%**
Coal	26,46	**38%**	1217	**30%**
Natural gas	11,04	**16%**	1381	**34%**
Diesel / FOil	2,08	3%	12	0%
Nuclear	0	0%	801	**20%**
Hydroelectric	23,7	**34%**	267	7%
Wind	1,97	3%	213	5%
Solar PV+Th	1,29	2%	44	1%
Biomass	1,89	3%	63	2%
Others	0,93	1%	89	2%
TOTAL	**69,36**		**4087**	